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Methods of Automated Model Transformations in Information System Analysis

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Abstract

The main goal of this PhD project is to develop methods that will automate processing of transformation from one model to another model in information system analysis. More generally bridge the gap between business models and information analytics models. These methods will be implemented and proved. Transformation method will have impact to the developed tool OpenCASE. Methods will be based on existing theory, but will be processed in not known form. Method approach will be based on Model-Driven Architecture. In this paper will be described transformation approaches model-to-model and model-to-text. This will be compared to already known transformation methods.

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Keywords: Transformation Method; Model Driven Architecture; Ontological Analysis; BORM Method; Tool Extension

1. Introduction

This project is based on the idea to bridge the gap between the two worlds: The world of business, which is focused on processes and understanding the economics, and the world of informatics, which today contains many modern tools and techniques for software development.

The modeling of Information Systems (IS) during the analysis phase is a crucial part of the IS development life-

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cycle. In the analytic phase, processes are tracked and modeled [3].

Modeling based on Model-Driven Architecture has a lot advantages for example metamodel mapping to model [11] and strong background of OMG [1]. The Model-Driven Architecture (MDA) [6] is an initiative by the Object Management Group (OMG) [1] to define an approach to software development based on modeling and automated mapping of models to implementations. The basic MDA pattern involves defining a platform-independent model (PIM) and its automated mapping to one or more platform-specific models (PSMs) [12].

This paper contains clearly formulation of the research question in this section 1 in subsection 1.2. Identifying a significant problem in the field of research in subsection 1.1. Outlines the current status of the problem domain and related solutions 2. Describes the research methodology that is applied or planned in section 3. Presents clearly any preliminary ideas, the proposed approach and the results achieved so far and outlines the contributions of the applicants work to the problem domain in section 4. Highlights contributions uniqueness in section 5.

1.1. Goal

My research idea is to develop a method of transformation that will cover the gap between business modeling and software modeling.

The objective of this PhD research project is a methodological framework to support an engineering approach to the development of IS (Information Systems) and more specifically model transformation in the analysis and design phases of IS development. The outputs will be verified using the prototype of a tool, which will perform this transformation.

1.2. Research Questions

Methods of transformation that will connect over gap between business modeling and software modeling. We can use techniques from graph theory and automata theory (FSM - finite state machine) to connect over gap between business modeling and software modeling. If we have model based on FSM we can use it for simulation and transformation to another model. This graph-based approach or FSM-based approach is objective to connect business modeling and software modeling.

- Explain how to transform business models like BPMN, BORM [5] or UML state, activity diagram to FSM based model.
- Explain how to transform business models like BORM to UML models like activity or state diagram and backwards.

2. Problem Background

Modeling and model transformations are parts of the analysis phase of the IS development. Business Process Model Notation (BPMN) – [9] and also Business Object Relation Modeling (BORM) [3, 5], are an inseparable parts of the IS development analysis phase. This approach is applied for all platforms (desktop, mobile and web applications). Nowadays, tools that support and perform transformations are requested, for example in [8]. The importance of transformation tools is explained in [10].

The Ontology-Centered Modeling [15] generally means to deal with terms and their relations. A more thorough introduction to ontologies and their relation to conceptual modeling and the BORM methodology may be found in our original paper [14]. Generally there are two main categories model to model and model to code, in case can be code subset of model and we can merge these two categories into one category model to model. Classification categories of model transformation approaches are [12]:

- direct manipulation
- relational
- graph-transformation-based
- structure driven
- hybrid

- other

According to my knowledge, this issue of my PhD thesis has not been solved. This theme is particularly current, as can be seen from topics of scientific articles and topics of conferences (arranged by Springer, AIS, IEEE, ACM). The idea of algorithmizable, and thereby automated transformation, promises easier implementation of business systems. An alternative approach is research ”Kermeta” research undertaken at the University of Rennes (www.kermeta.org) (16), which approaches the issue using metamodeling.

3. Methodology

My methodology is separated into steps. Steps can be processed in cycle with loops and with jumps, but cannot skip any of the steps, because it continuous process. The very first step is research onto the state of art in the topic of current tools and approaches for model transformation and models like BPMN, BORM and UML. Next step is summarization of research and write publications about this research. The inspiration will be taken by summarization take for new approach and write best practices onto current approaches. Analysis of possibilities to connect models, for example BPMN and UML. Creating methodological framework for transformations. Another step is also implement extension for existing tool OpenCASE [15]. This extension will support automated transformations between models based on MDA (model driven architecture). The extension of OpenCASE will be tested with students and results will be published. Testing covers interview and surveys with users for collecting data. Collected date will be analyzed and transformed for publication.

- 1th step research onto the state of the art in the topic of current tools and approaches for models BPMN, BORM and UML.
- 2nd step summarized state of the art from 1st step.
- 3rd step analyzing of possibilities to connecting models, for example BPMN and UML. Creating methodological framework for transformations.
- 4th step definition of requirements for and automated tool, which will be able to transform a model for example from BPMN to UML.
- 5th step design of tool extension. Publications will be submitted.
- 6th step implementation prototype of the tool extension.
- 7th step designing sample examples in prototype tool extension.
- 8th step impact of project will proved with statistical methods.
- 9th step writing final thesis.
- NB: all steps will be published on a website dedicated to project, and contributions will be submitted to scientific journals or proceedings.

4. Results

4.1. Transformation Experience

My achievements are based on a knowledge into transformation fundamentals, which were learned while preparing my Bachelor thesis [17] and my Master thesis [18]. I also have practical experience in software development. My first step was my Bachelor’s thesis [17] that focused on the transformation of XML document into a web site. The transformation was implemented in JavaScript. My next step was my Master’s thesis [18]. It was a framework based on Model Driven Architecture (MDA) for generating a web application prototype. The whole framework was programmed in Java during the period from 2009 to 2011 at the Czech Technical University in Prague. Java is also practiced at University of Lugano [22, 4]. Before I became a PhD. student at the Czech University of Life Sciences in Prague (CULS). I wanted to use and expand my experience of the business domain from my Bachelor’s and Master’s studies. This explains why I am interested in BPMN [9] and I have conducted research about BPMN standards and have completed a study [19]. I am also interested in object modeling and normalization [13]. I have participated in the development of the OpenCASE [2] tool in Java I practiced Java for

three years in the private sector (practice). I also have experience with functional programming in Clojure (derived from Lisp), and I am already using this experience in scientific research. My latest achievement is a publication of the OpenCase tool, together with a colleague from department [15]. At CULS I teach courses on Component-based SW Development, and Data and Knowledge modeling. I participate in several Faculty and University grants. I have participated in a number of domestic and foreign conferences. I have publications with my supervisor [13] and colleagues from the department (DIE - Department of Information Engineering) where I am studying [15].

4.2. Tool Extension

OpenCASE is database-centered, i.e. it maintains an internal knowledge based containing of functions, scenarios, diagrams, entities, elements together with their graphical properties [15]. In my case model form nodes of a graph structure and their relations are represented as edges [15], thus various graph algorithms may be applied on the knowledge base [21].

4.3. Case Study

The Case study deals with the process of trace identification method (MPI) used in criminalistics. Just a part of the process is presented here due to space limitations. The case study is focused on collecting trace samples and its analysis. The process covers collecting of trace samples. The case study was developed with cooperation of the Faculty of Agrobiology, Food and Natural Resources, namely we would like to thank Ing. Petr Vlasak from Canine Behavior Research Center. We will use here just a simplified version to demonstrate the concepts presented in the paper.

The MPI process here is carried out by cooperation between four participants: Regional institution Distribution, Territorial criminal technician, Regional institution Analysis and Inspector. The whole case study is shown in figure 1.

The case study for developing purposes is based on interview with canine expert. The topic of case study is canine recognition of trace samples. Interview was processed into business process model published [20]. In this case study will be processed impact of methodological transformation framework.

5. Conclusion

My goal is deterministic in approach and in methods, which I use for, automated transformation between models. I will analyze already known possible methods and formulate best practices and set new approaches for my goal. This approach will be formulated and implemented.

First subgoal is formulate and prove methodical transformation framework. Formulation and proving will be madden in theoretical mathematical rigorous formulas and also will be proven. This formulation will be based on definitions and their proofs.

Subgoal is implement and test methodical transformation framework. This developed framework will be extension of the current tool OpenCASE [15]. Next subgoal is to prepare this framework for standardization. This part will not be easy and can take approximately more than eight years from prototype to OMG standard.

Another subgoal toward the holistic ontology-centred conceptual modeling will be implementing other types of diagrams, especially data- structure diagrams (UML Class Diagrams and OntoUML, [7]) and providing a means to make ontologic relations to the process diagrams [15].

In this paper, I formulated main research question and subquestion, I wrote my goal and subgoals of my PhD thesis, I described state of the art in my topic model-to-model transformation, I subscribed methodology, which was used and will be used for my project, I described previous results and I highlight uniqueness of my project contribution. My future plan is statistical research of developed methods in practice.

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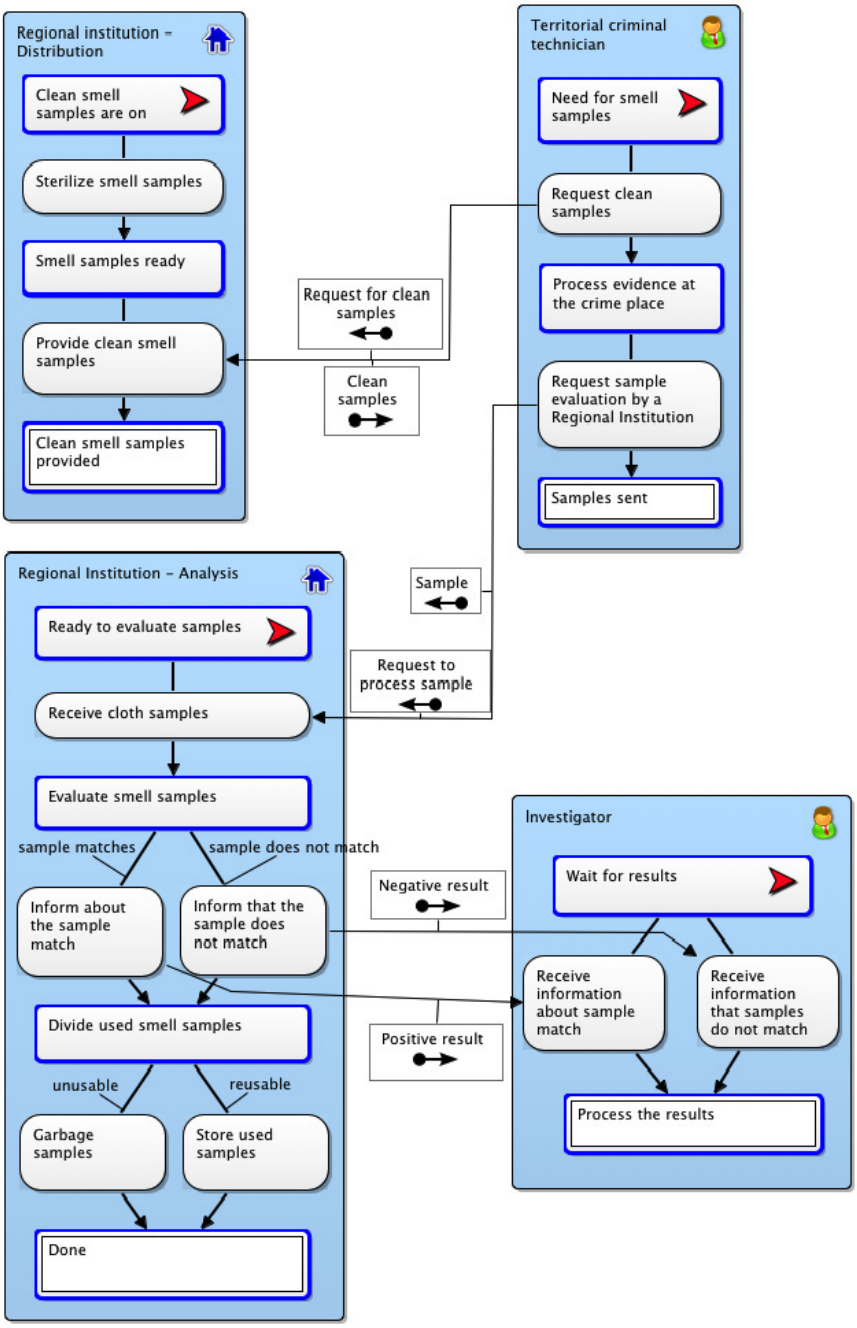

Fig. 1. Case study management process model in BORM: Partial Phase of MPI

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